Data science for lazy people, Automated Machine Learning

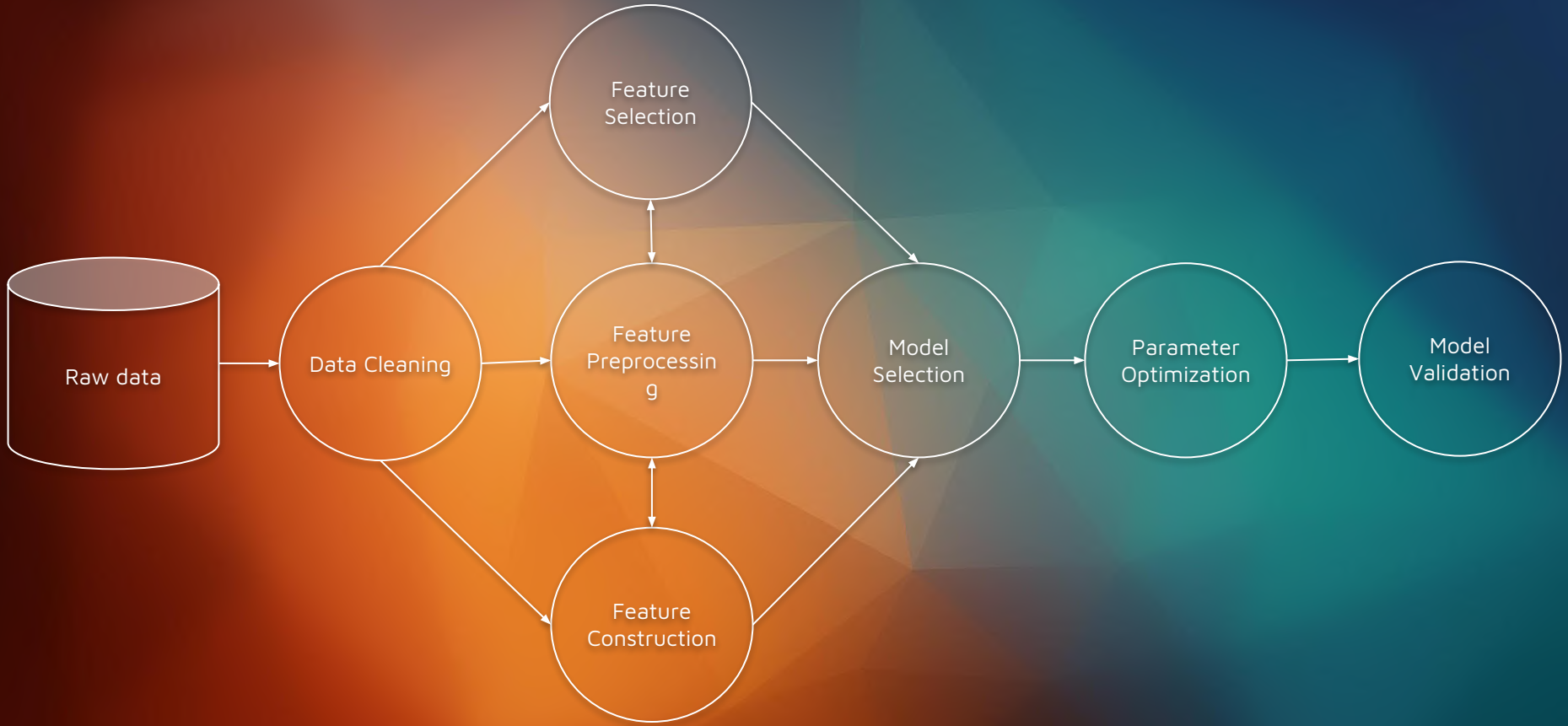
Big Data Congress Lithuania 2018

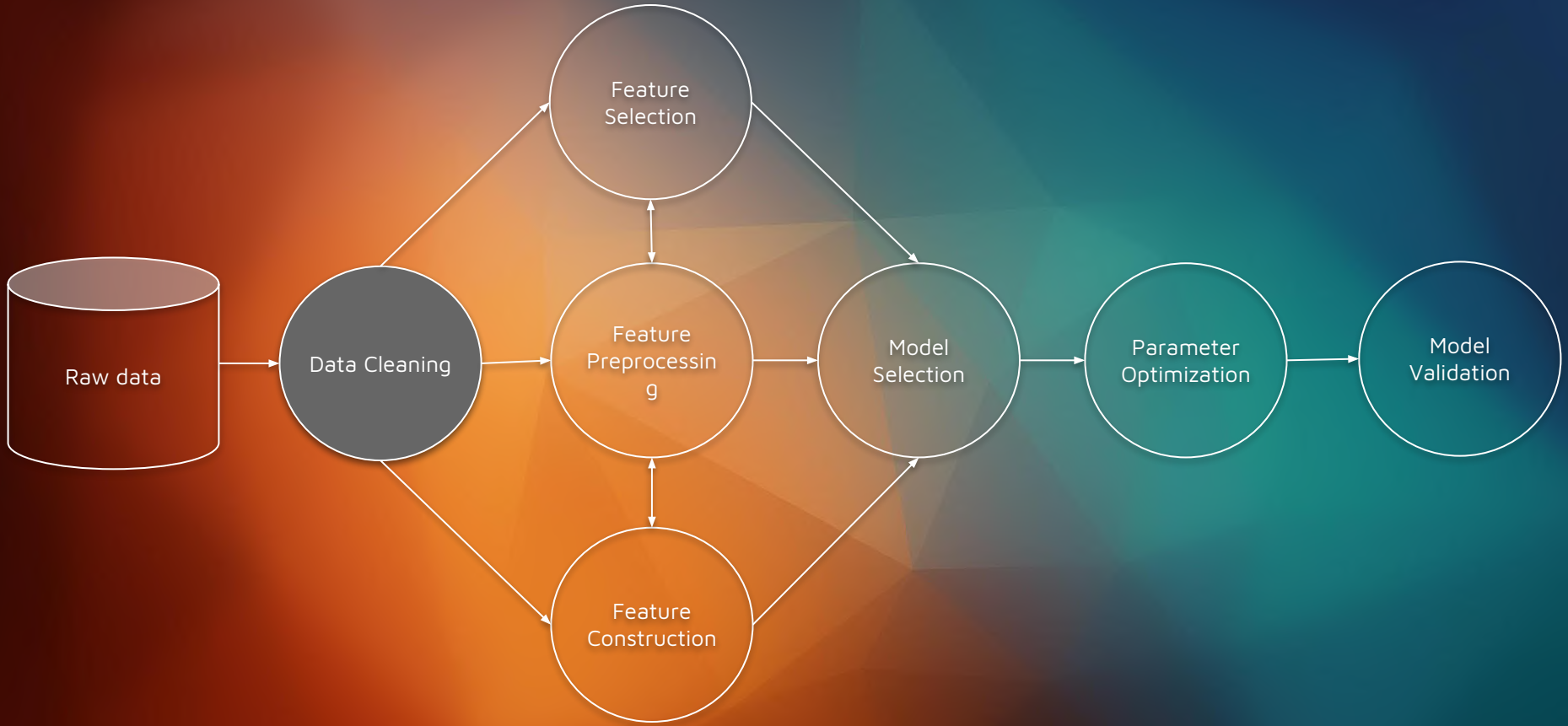
Diego Hueltes

 @jdiegoh

https://www.sli.do

#bigdata2018


Feature Selection
Raw data
Data Cleaning
Feature Preprocessing
Model Selection
Parameter Optimization
Model Validation
Feature Construction


Raw data
Data Cleaning
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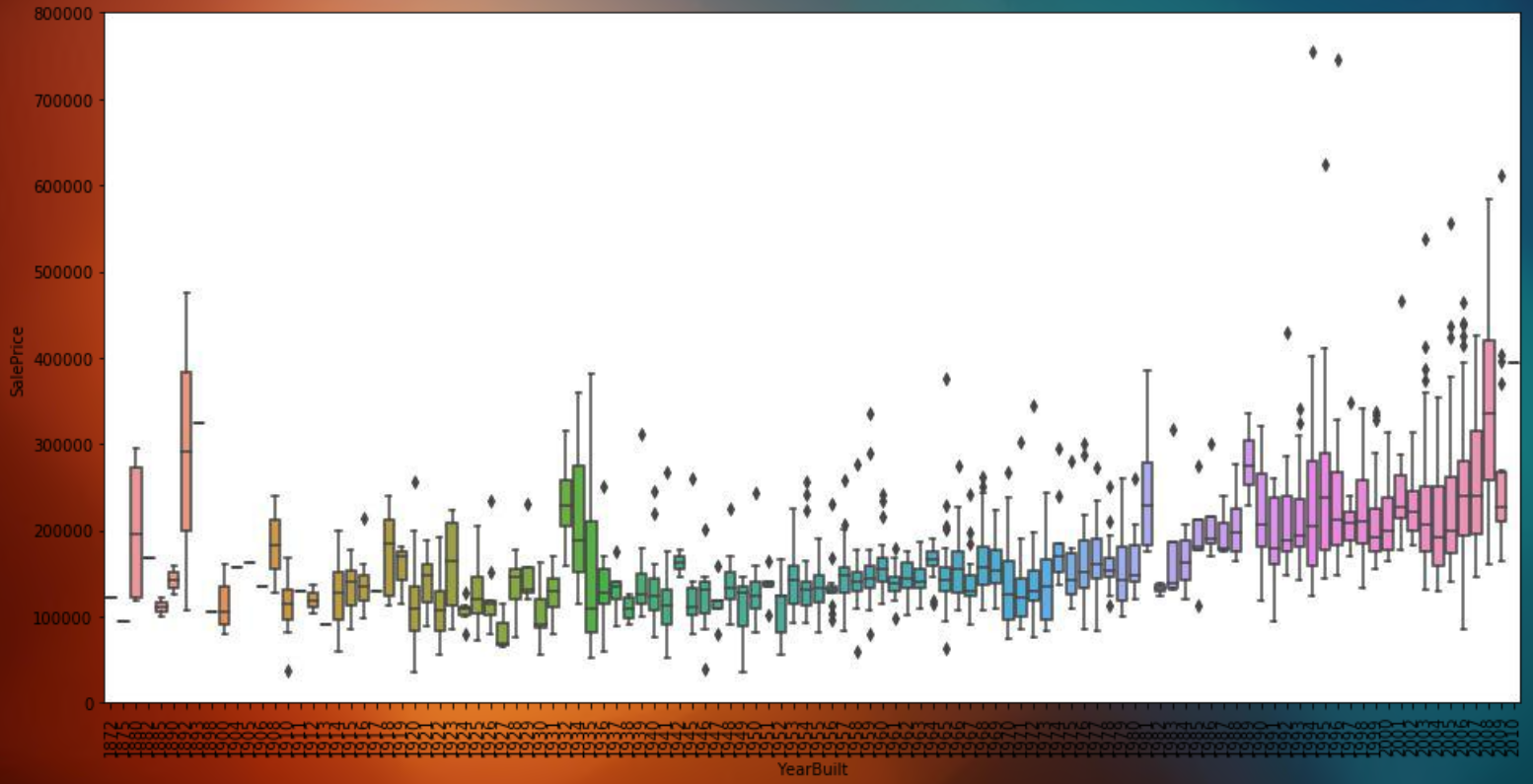
Feature Preprocessing
Feature Construction
Model Selection
Parameter Optimization
Model Validation

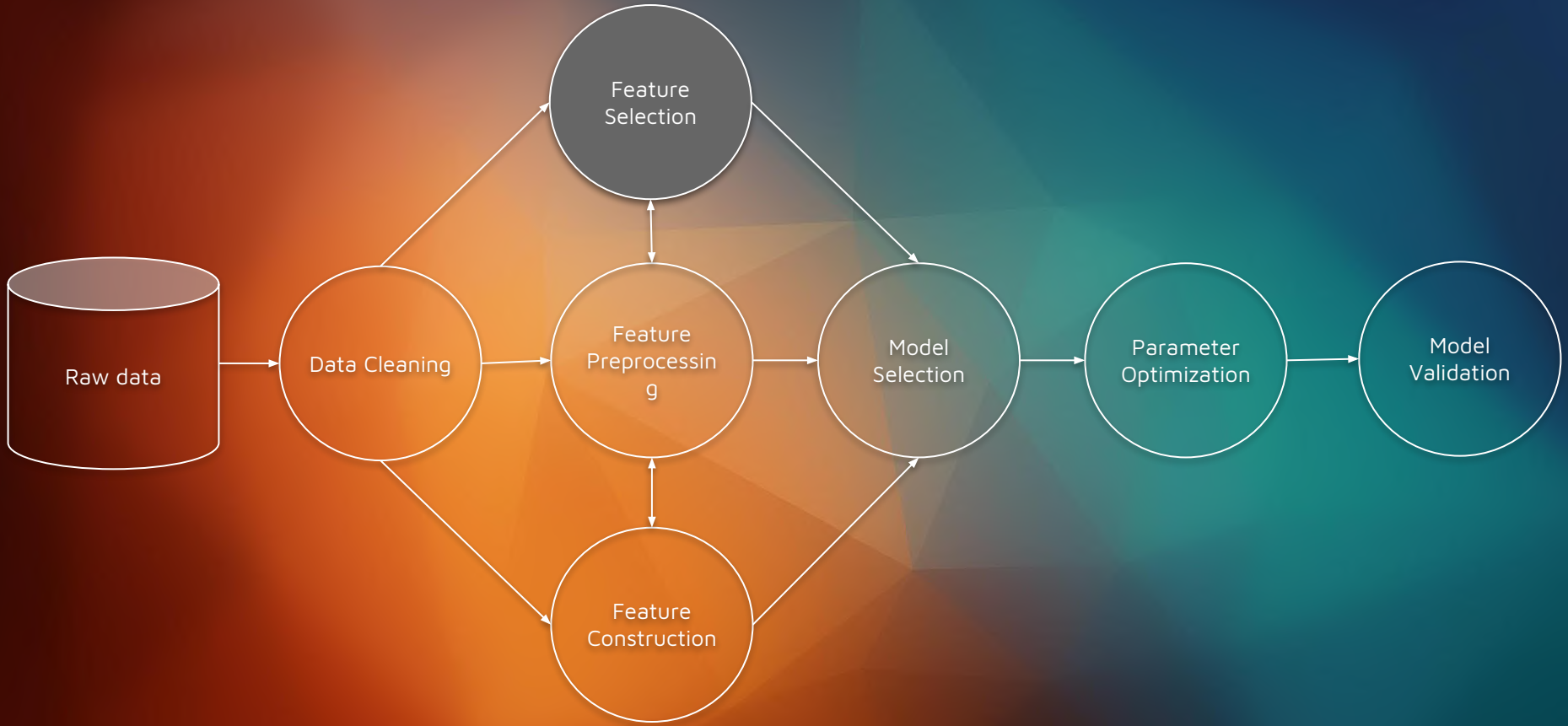
Data cleaning

Data cleaning

4.9	3.1	1.5	NA	Iris-setosa
5.4	3.7	1.5	NA	Iris-setosa
4.8	3.4	1.6	NA	Iris-setosa
4.8	3.0	1.4	0.1	Iris-setosa
5.7	3.0	1.1	0.1	Iris-setosa
5.8	4.0	1.2	0.2	Iris-setosa
5.7	4.4	1.5	0.4	Iris-setosa
5.4	3.9	1.3	0.4	Iris-setosa
5.1	3.5	1.4	0.3	Iris-setosa
5.7	3.8	1.7	0.3	Iris-setossa
5.1	3.8	1.5	0.3	Iris-setosa

Data cleaning

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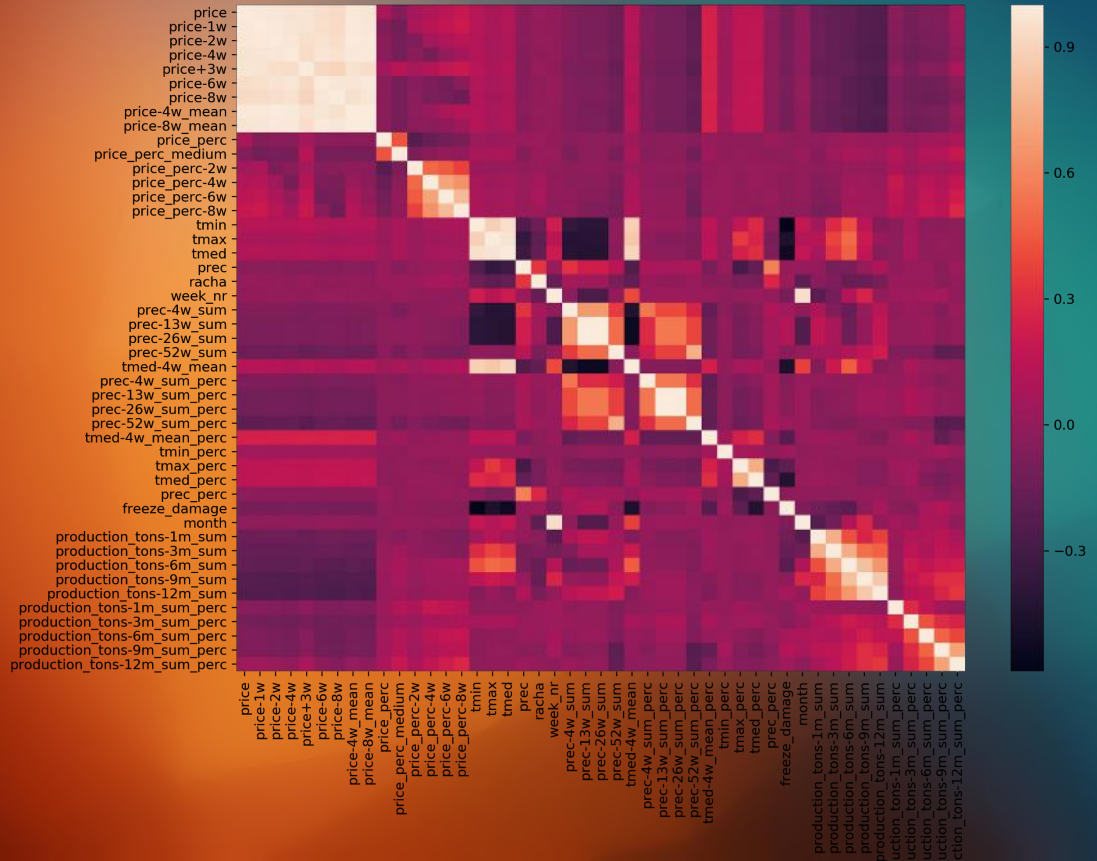
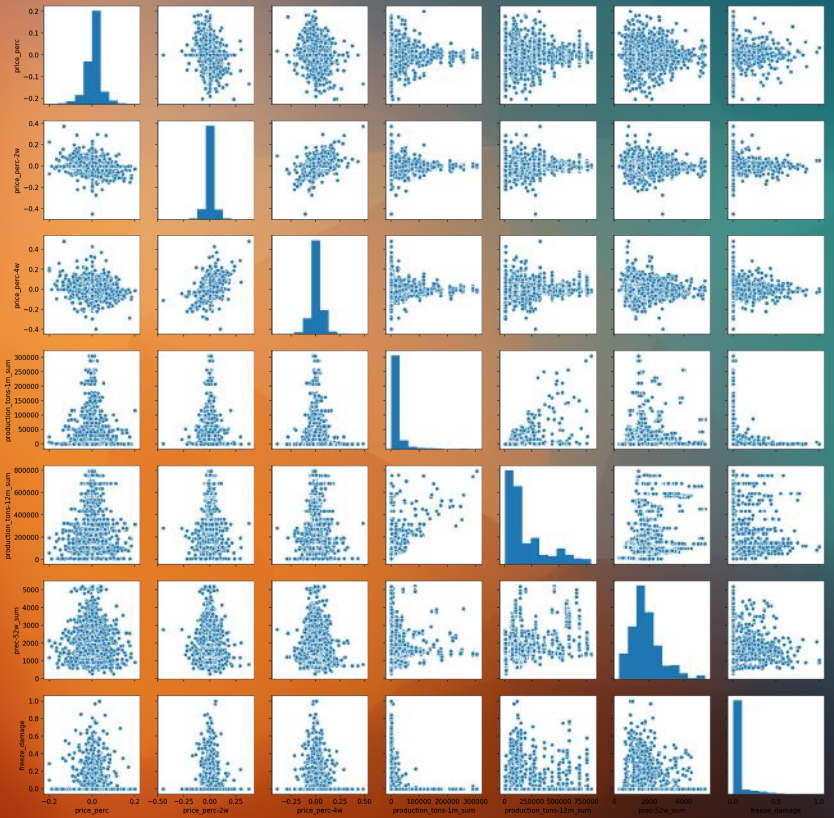
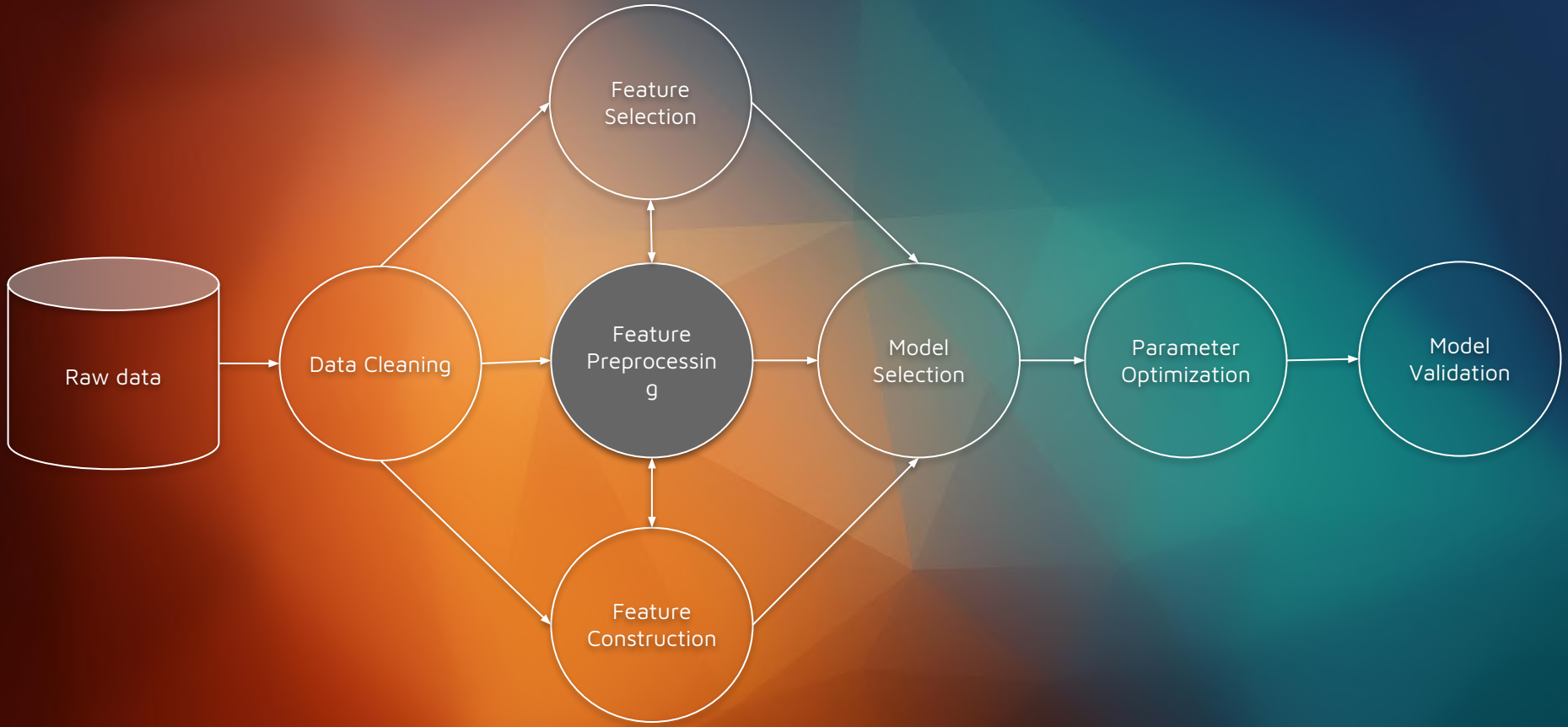
Feature selection



Feature selection

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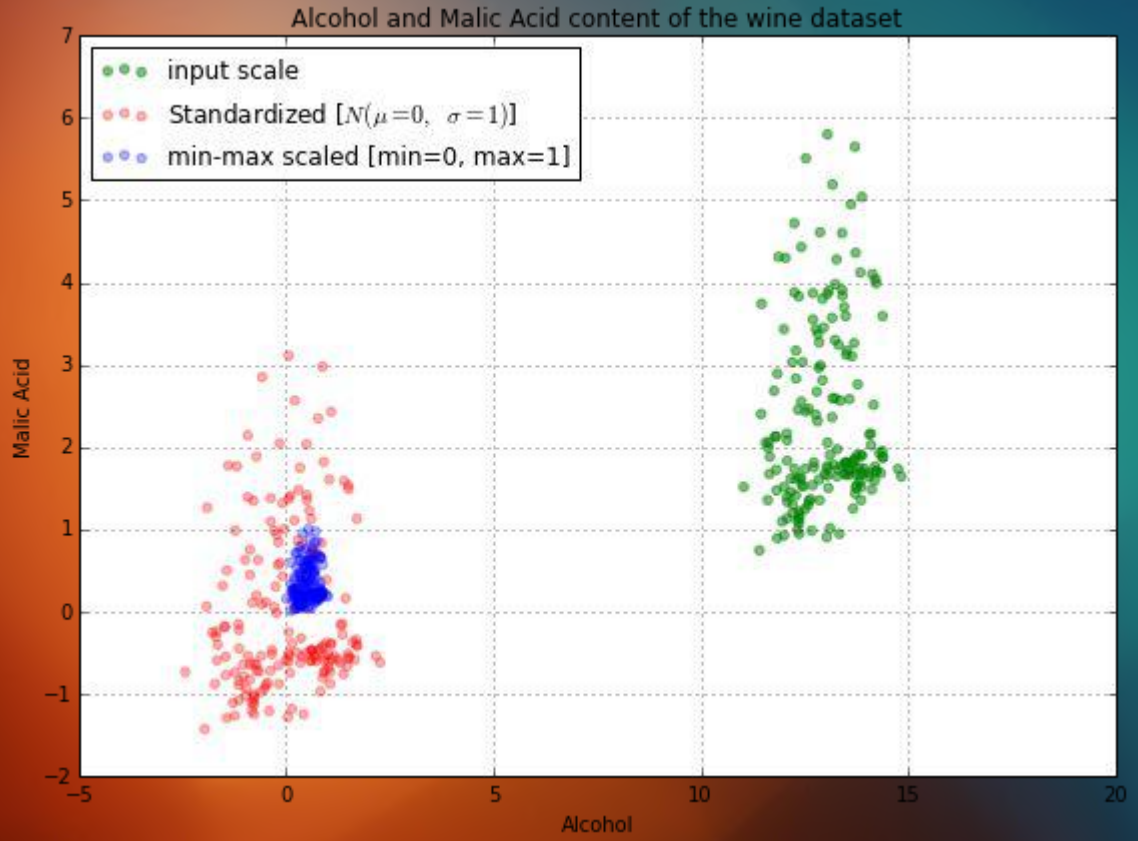
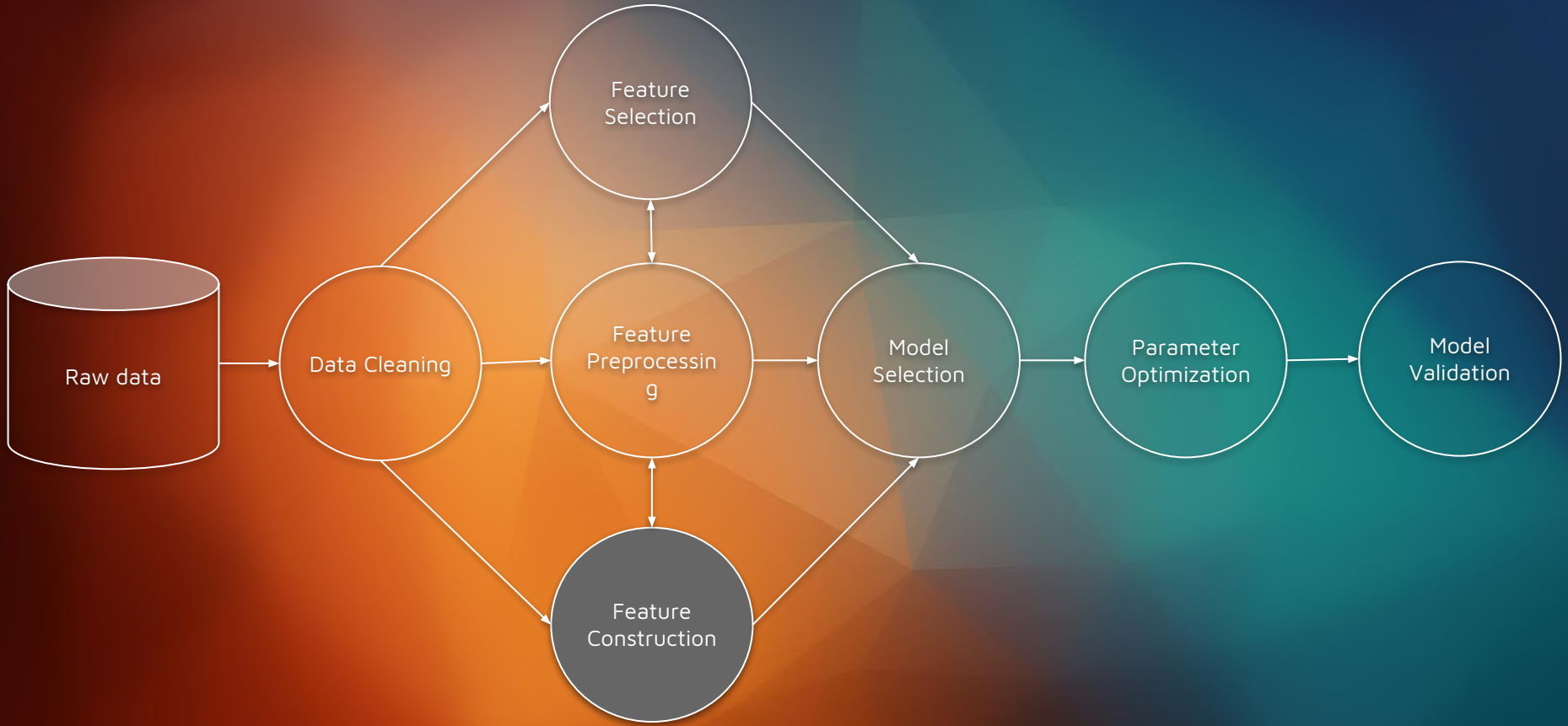
Feature preprocessing




Feature Selection
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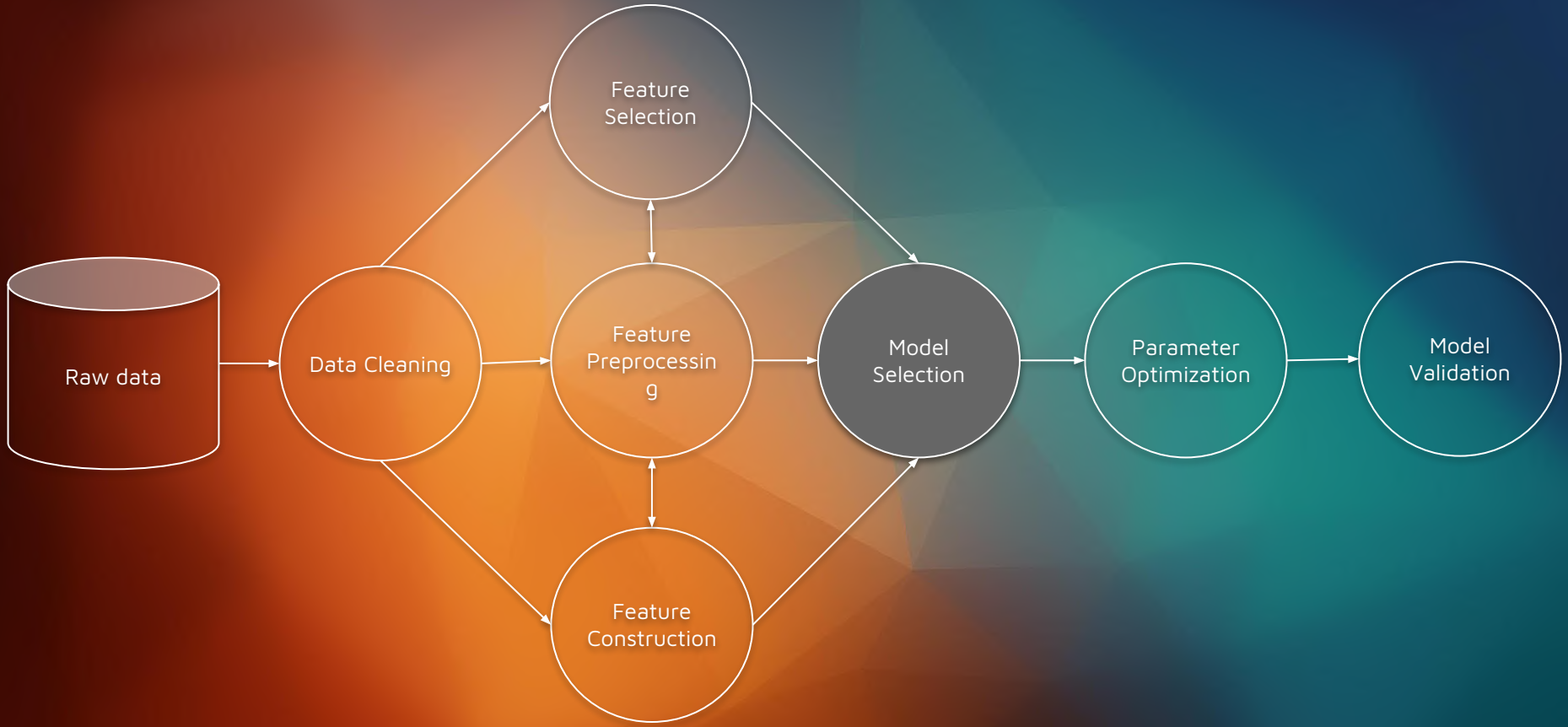
Feature construction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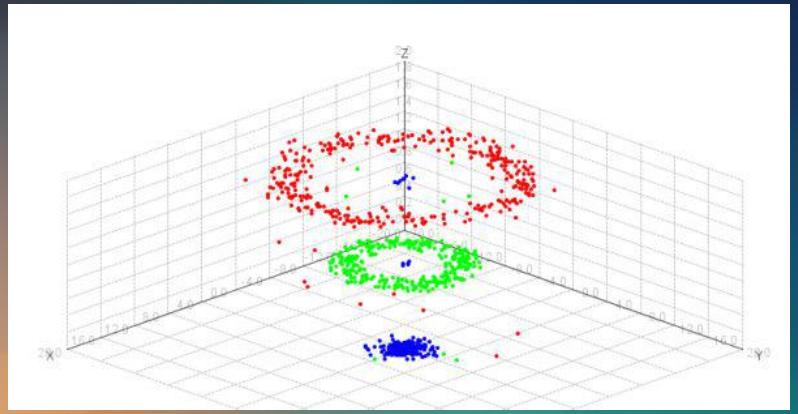
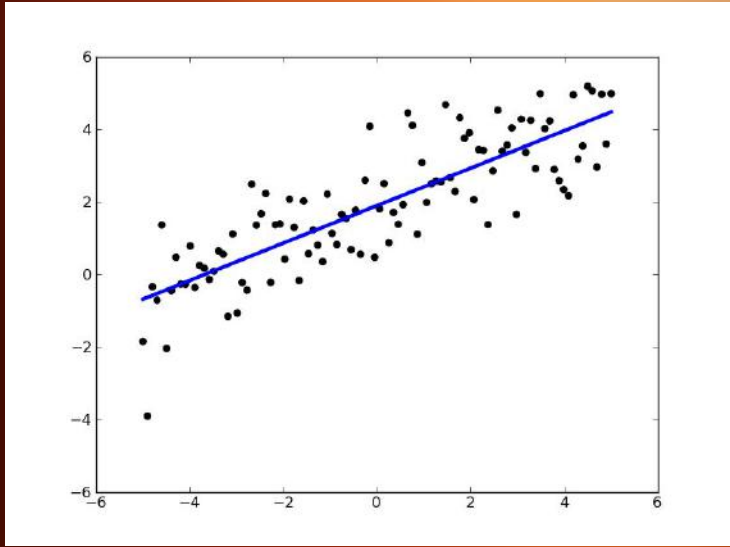
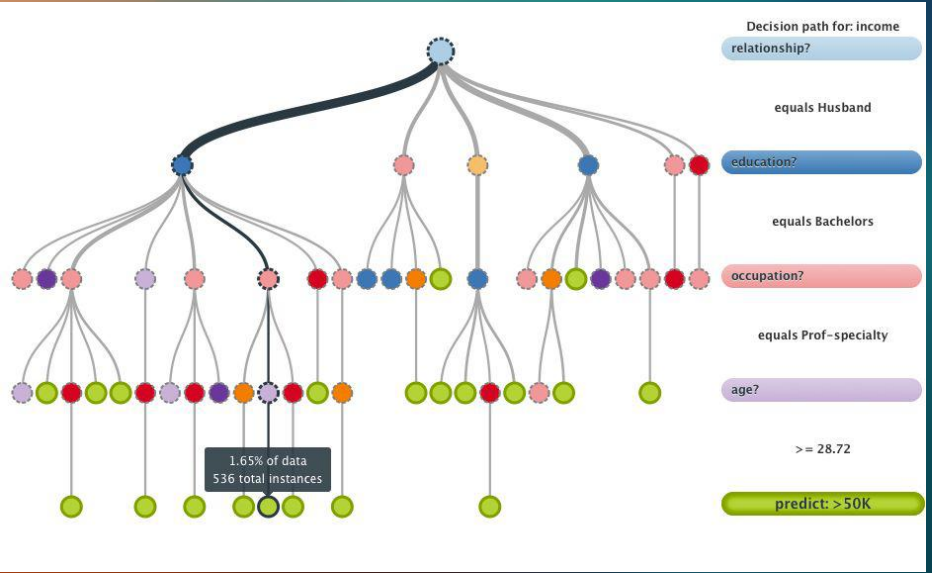
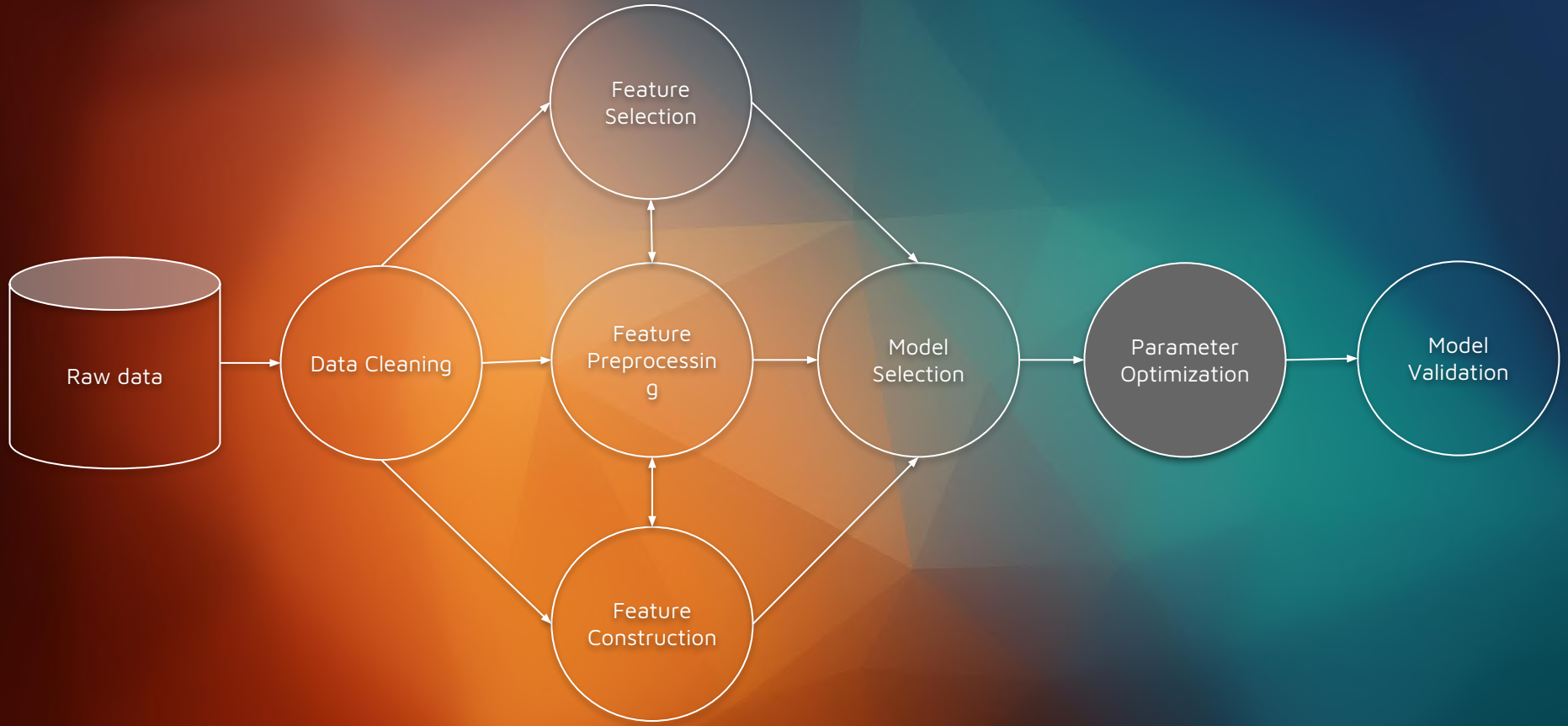
Model selection





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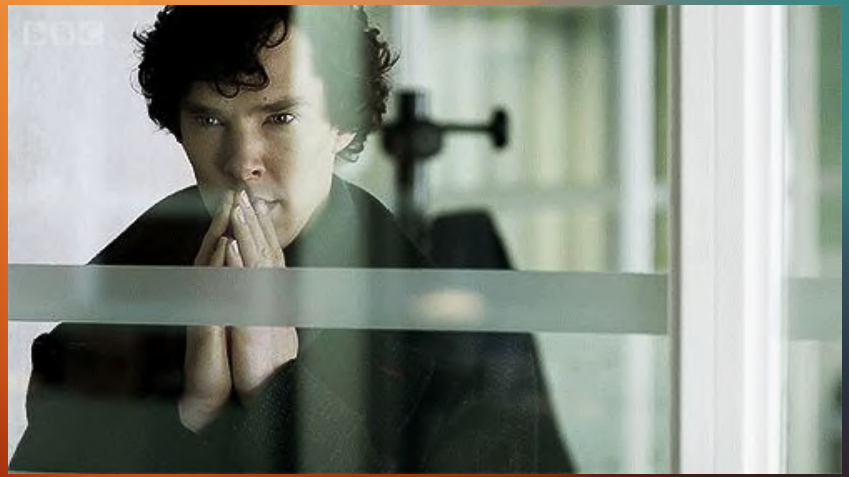
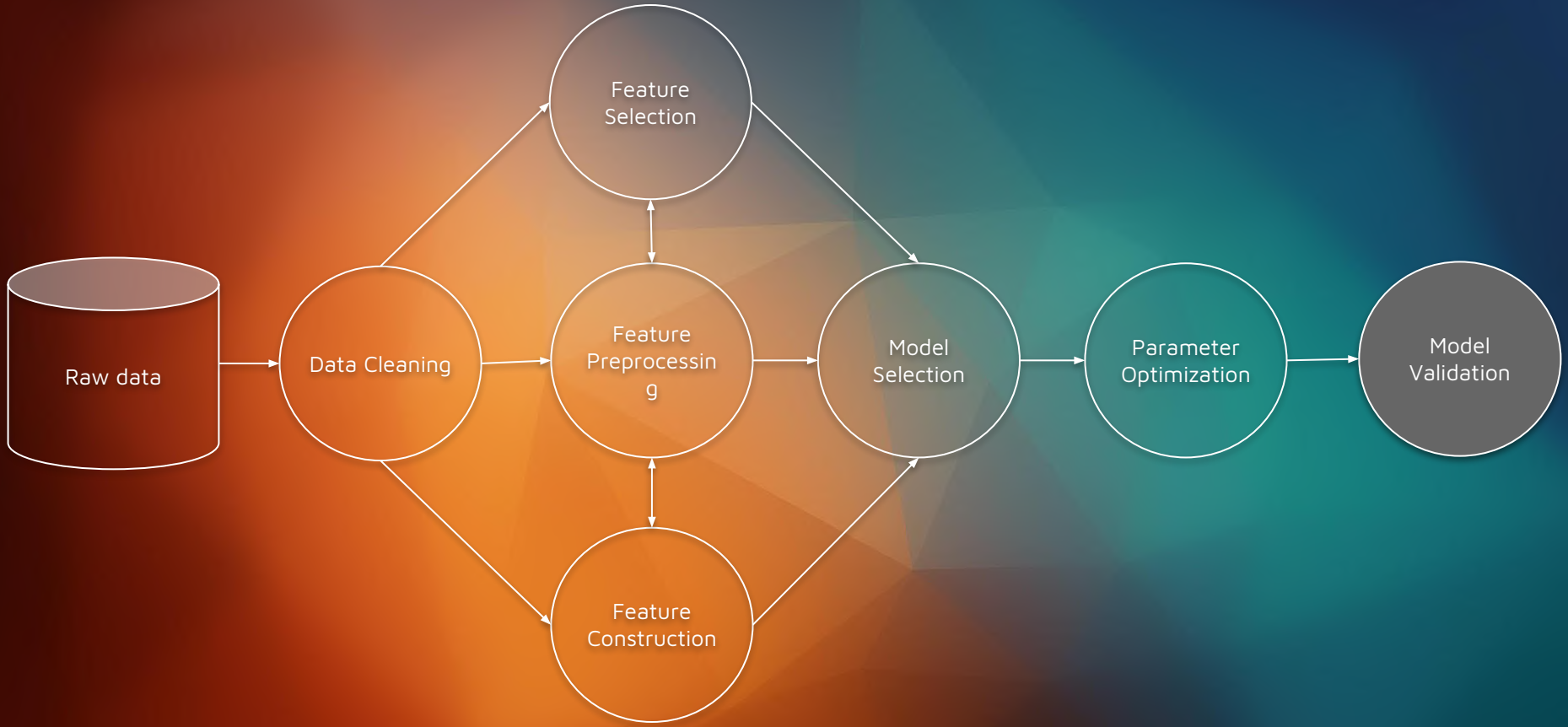
Parameter optimization

```
RandomForestClassifier(bootstrap=True, class_weight=None, criterion='gini',
            max_depth=2, max_features='auto', max_leaf_nodes=None,
            min_impurity_decrease=0.0, min_impurity_split=None,
            min_samples_leaf=1, min_samples_split=2,
            min_weight_fraction_leaf=0.0, n_estimators=10, n_jobs=1,
            oob_score=False, random_state=0, verbose=0, warm_start=False)
```

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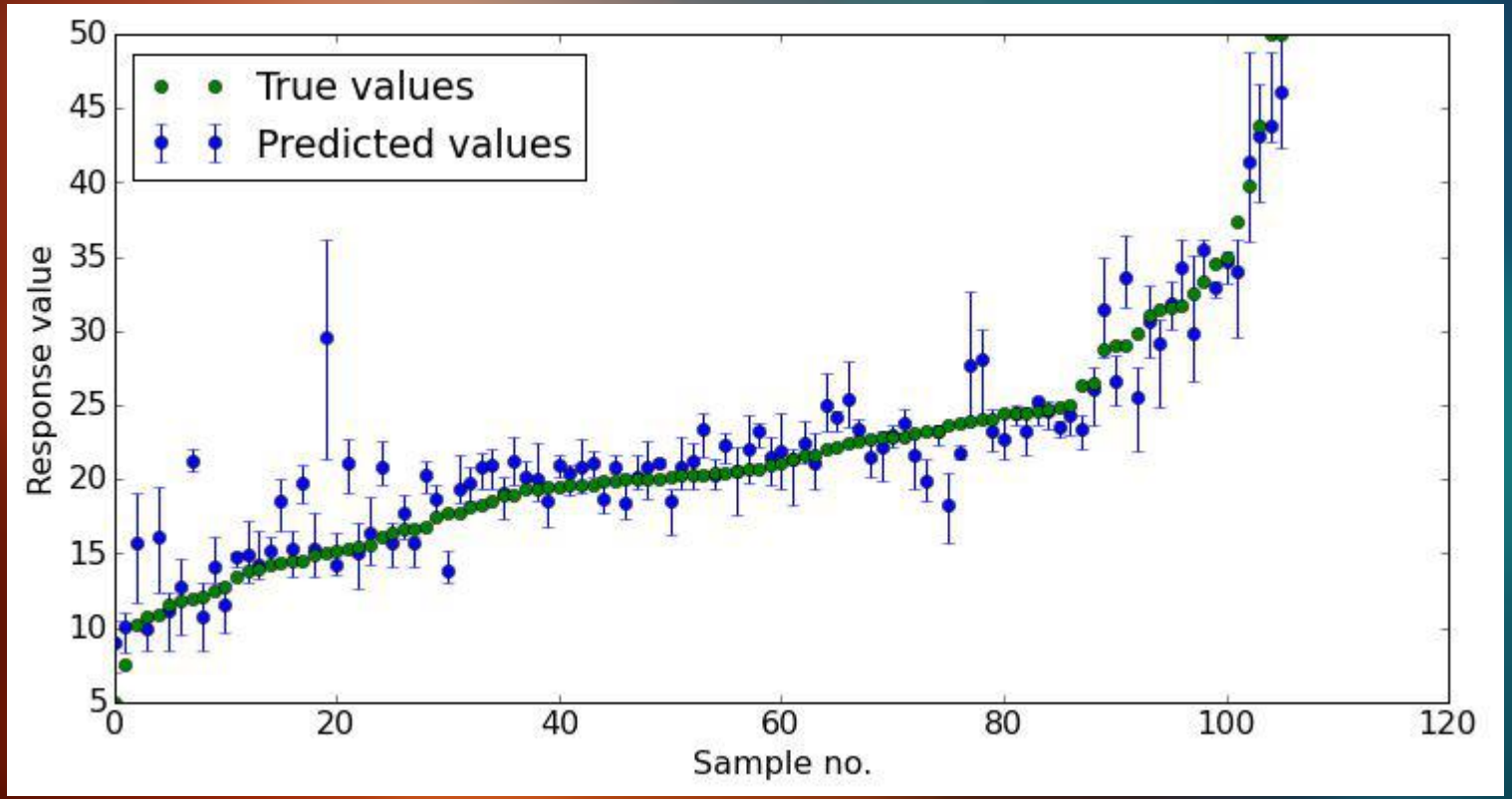
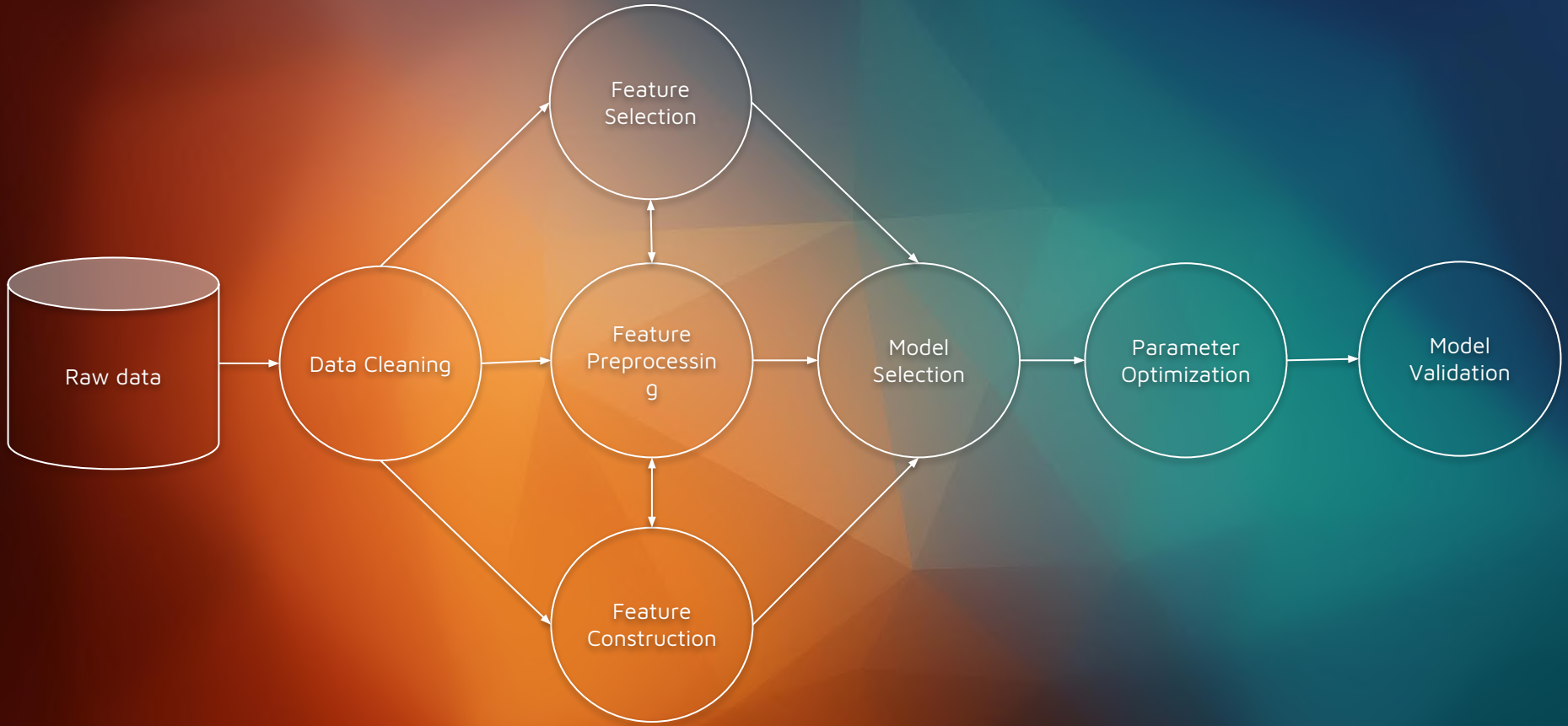
Model validation

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lazy

Oxford dictionary

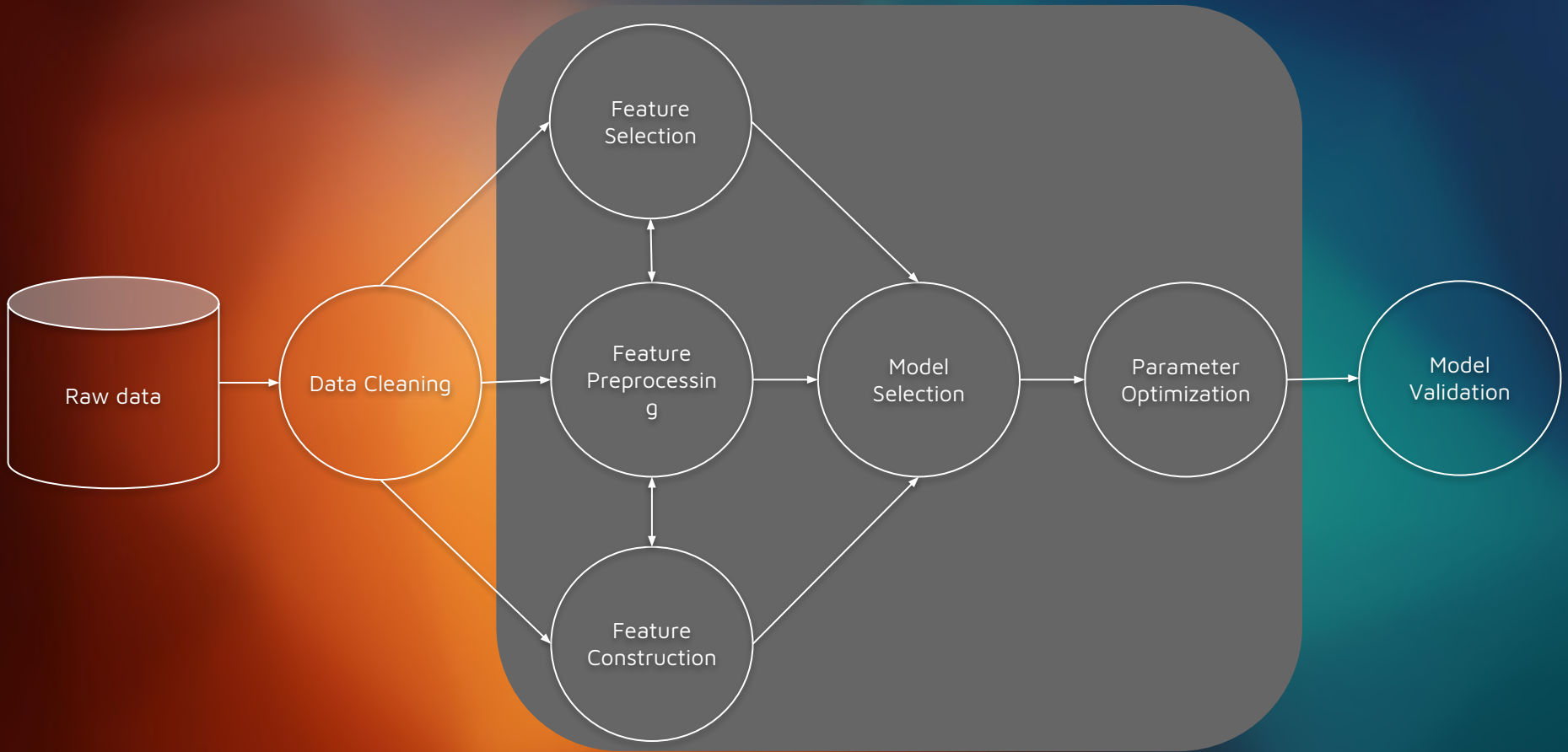
Unwilling to work or use energy

lazy

Diego dictionary

~~Oxford dictionary~~

Unwilling to work or use energy in repetitive tasks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naive_bayes.GaussianNB
tree.DecisionTreeClassifier
feature_selection.SelectFwe
ensemble.ExtraTreesRegressor
neighbors.KNeighborsRegressor
xgboost.XGBRegressor
ensemble.RandomForestRegressor
kernel_approximation.RBFSampler
preprocessing.MaxAbsScaler
linear_model.LogisticRegression
preprocessing.PolynomialFeatures
naive_bayes.MultinomialNB
feature_selection.SelectFromModel
preprocessing.RobustScaler
linear_model.ElasticNetCV
neighbors.KNeighborsClassifier
cluster.FeatureAgglomeration
preprocessing.Normalizer
feature_selection.VarianceThreshold
ensemble.GradientBoostingClassifier
decomposition.PCA
feature_selection.SelectPercentile
naive_bayes.BernoulliNB
svm.LinearSVR
ensemble.ExtraTreesClassifier
ensemble.AdaBoostRegressor
linear_model.LassoLarsCV
preprocessing.StandardScaler
tree.DecisionTreeRegressor
xgboost.XGBClassifier
tpot.builtins.ZeroCount
decomposition.FastICA
svm.LinearSVC
preprocessing.Binarizer
feature_selection.RFE
preprocessing.MinMaxScaler
linear_model.RidgeCV
kernel_approximation.Nystroem
ensemble.GradientBoostingRegressor
ensemble.RandomForestClassifier

Automated Machine Learning

TPOT

Auto-Sklearn

Auto-Weka

Machine-JS

DataRobot

auto_ml

Google Cloud AutoML

AutoKeras

H2O AutoML

...

TPOT is a Python tool that automatically creates and optimizes **machine learning pipelines** using **genetic programming**.

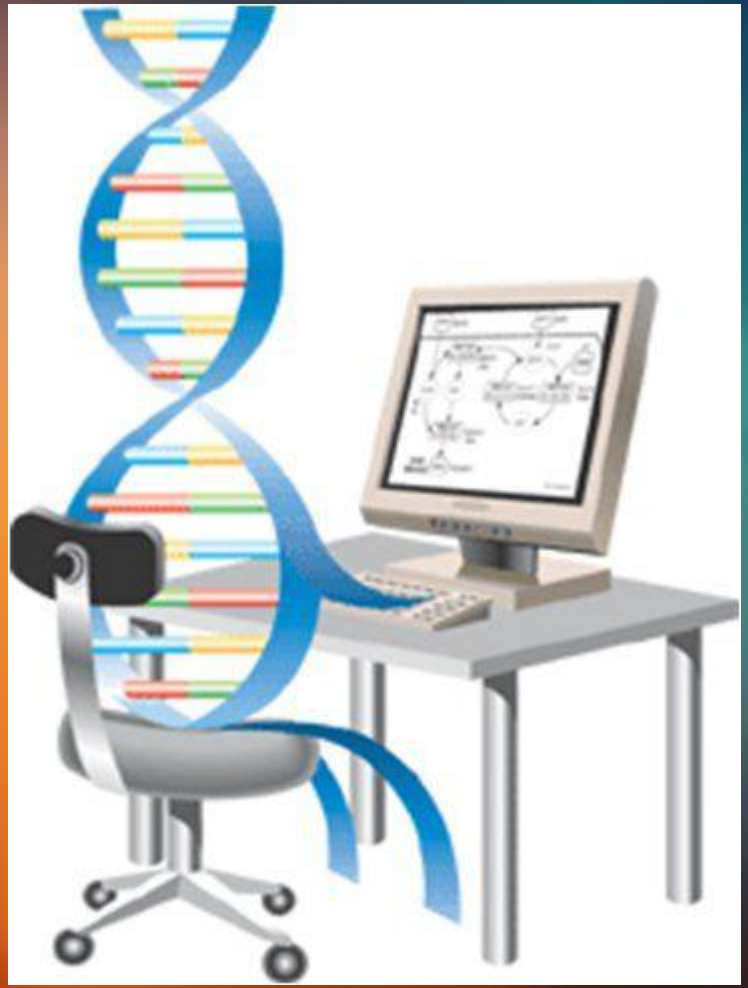
https://github.com/EpistasisLab/tpot

auto-sklearn

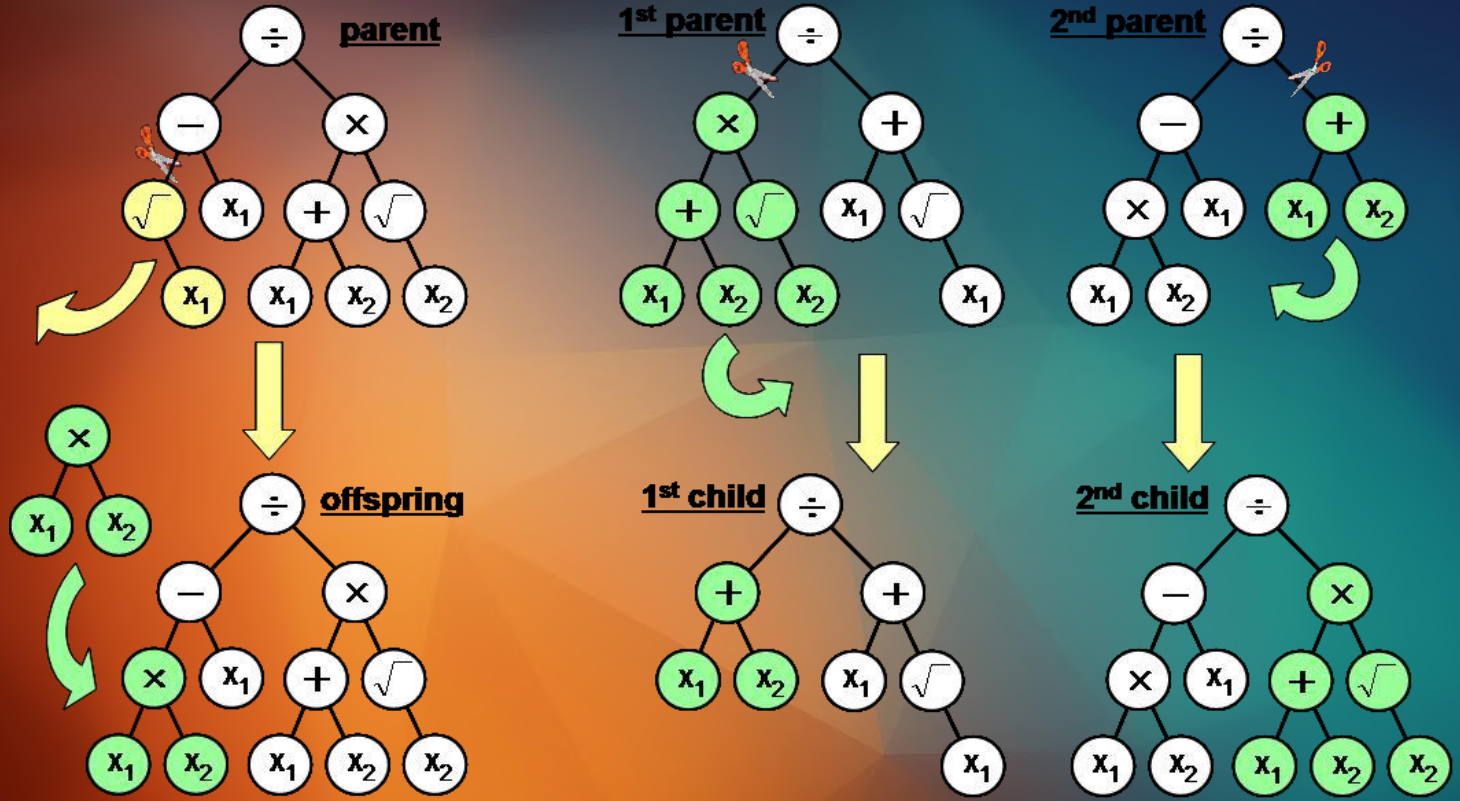
auto-sklearn frees a machine learning user from algorithm selection and hyperparameter tuning. It leverages recent advantages in **Bayesian optimization**, **meta-learning** and **ensemble construction**

https://github.com/automl/auto-sklearn

Genetic programming



Source: http://www.genetic-programming.org/gpbook4toc.html

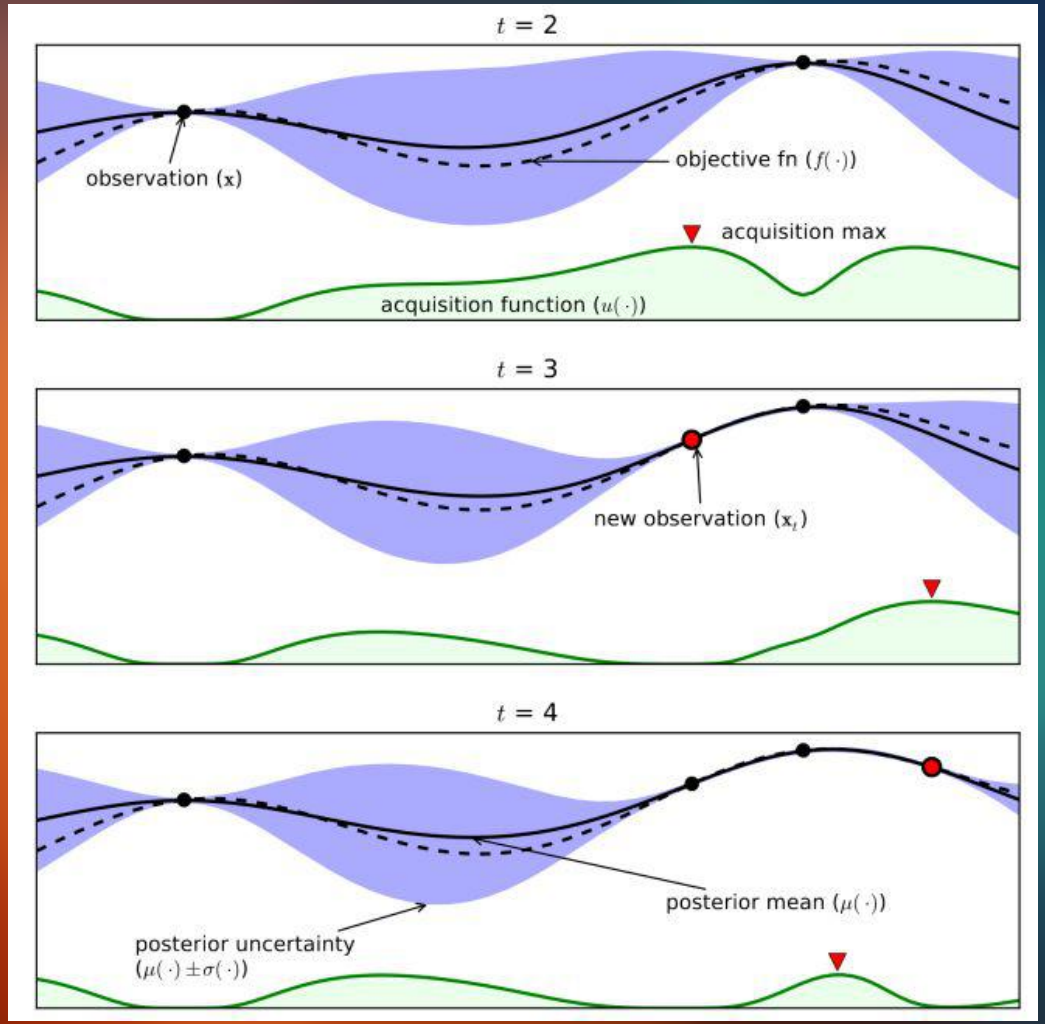


Mutation

Crossover

Source: http://w3.onera.fr/smac/?q=tracker

Bayesian optimization



source: https://advancedoptimizationatharvard.wordpress.com/2014/04/28/bayesian-optimization-part-ii/

TPOT is a Python tool that automatically creates and optimizes **machine learning pipelines** using **genetic programming**.

https://github.com/EpistasisLab/tpot

TPOT

```
from tpot import TPOTClassifier, TPOTRegressor


tpot = TPOTClassifier()
tpot.fit(X_train, y_train)
predictions = tpot.predict(X_test)


tpot = TPOTRegressor()
tpot.fit(X_train, y_train)
predictions = tpot.predict(X_test)
```

TPOT - configuration

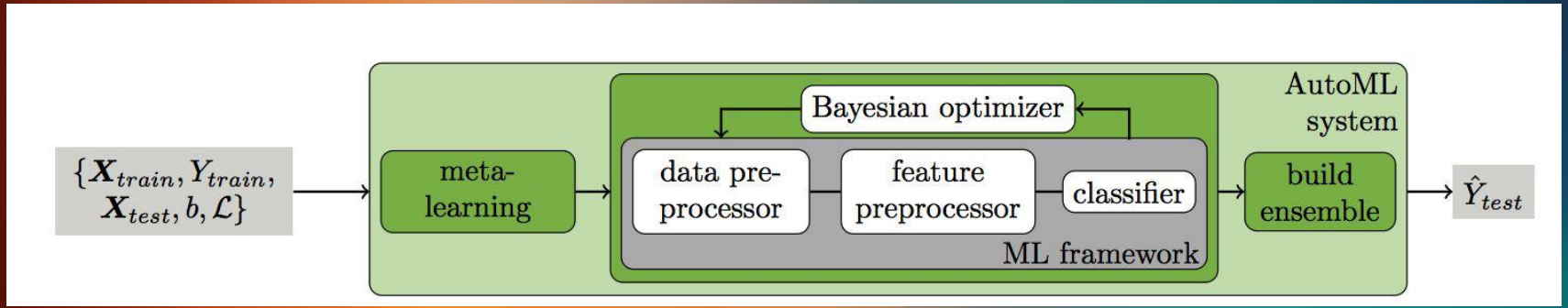
```
TPOTClassifier( config_dict  = {
   'sklearn.ensemble.RandomForestClassifier' : {
       'n_estimators' : [100],
       'criterion' : ["gini", "entropy"],
       'max_features' : np.arange( 0.05, 1.01, 0.05),
       'min_samples_split' : range(2, 21),
       'min_samples_leaf' :  range(1, 21),
       'bootstrap' : [True, False]
   },
   'sklearn.feature_selection.RFE' : {
       'step': np.arange( 0.05, 1.01, 0.05),
       'estimator' : {
           'sklearn.ensemble.ExtraTreesClassifier' : {
               'n_estimators' : [100],
               'criterion' : ['gini', 'entropy'],
               'max_features' : np.arange( 0.05, 1.01, 0.05)
              }
       }
   }
})
```

auto-sklearn

auto-sklearn frees a machine learning user from algorithm selection and hyperparameter tuning. It leverages recent advantages in **Bayesian optimization**, **meta-learning** and **ensemble construction**

https://github.com/automl/auto-sklearn

auto-sklearn



Source: http://papers.nips.cc/paper/5872-efficient-and-robust-automated-machine-learning.pdf

auto-sklearn

```
import autosklearn.classification
import autosklearn.regression

automl = autosklearn.classification.AutoSklearnClassifier()
automl.fit(X_train, y_train)
predictions = automl.predict(X_test)


automl = autosklearn.regression.AutoSklearnRegressor()
automl.fit(X_train, y_train)
predictions = automl.predict(X_test)
```

auto-sklearn custom config

include_estimators

exclude_estimators

include_preprocessors

exclude_preprocessors

Olive oil full dataset...

Test in Google Colab, clean dataset.

Tomorrow at 12:15

Hall 5

Olive oil full dataset...

Test in Google Colab, clean dataset.

TPOT: 55% Accuracy

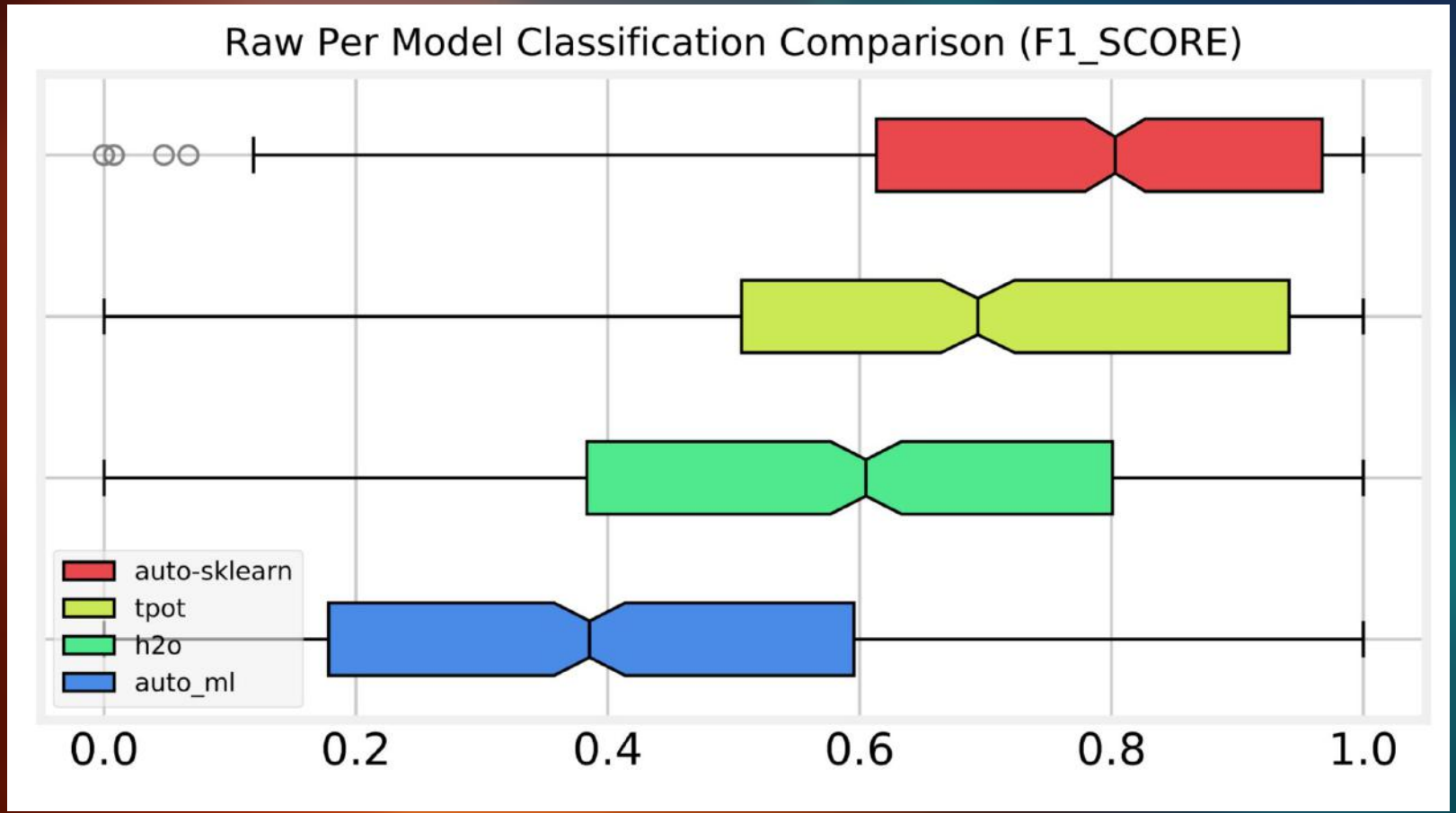
auto-sklearn: 56% Accuracy

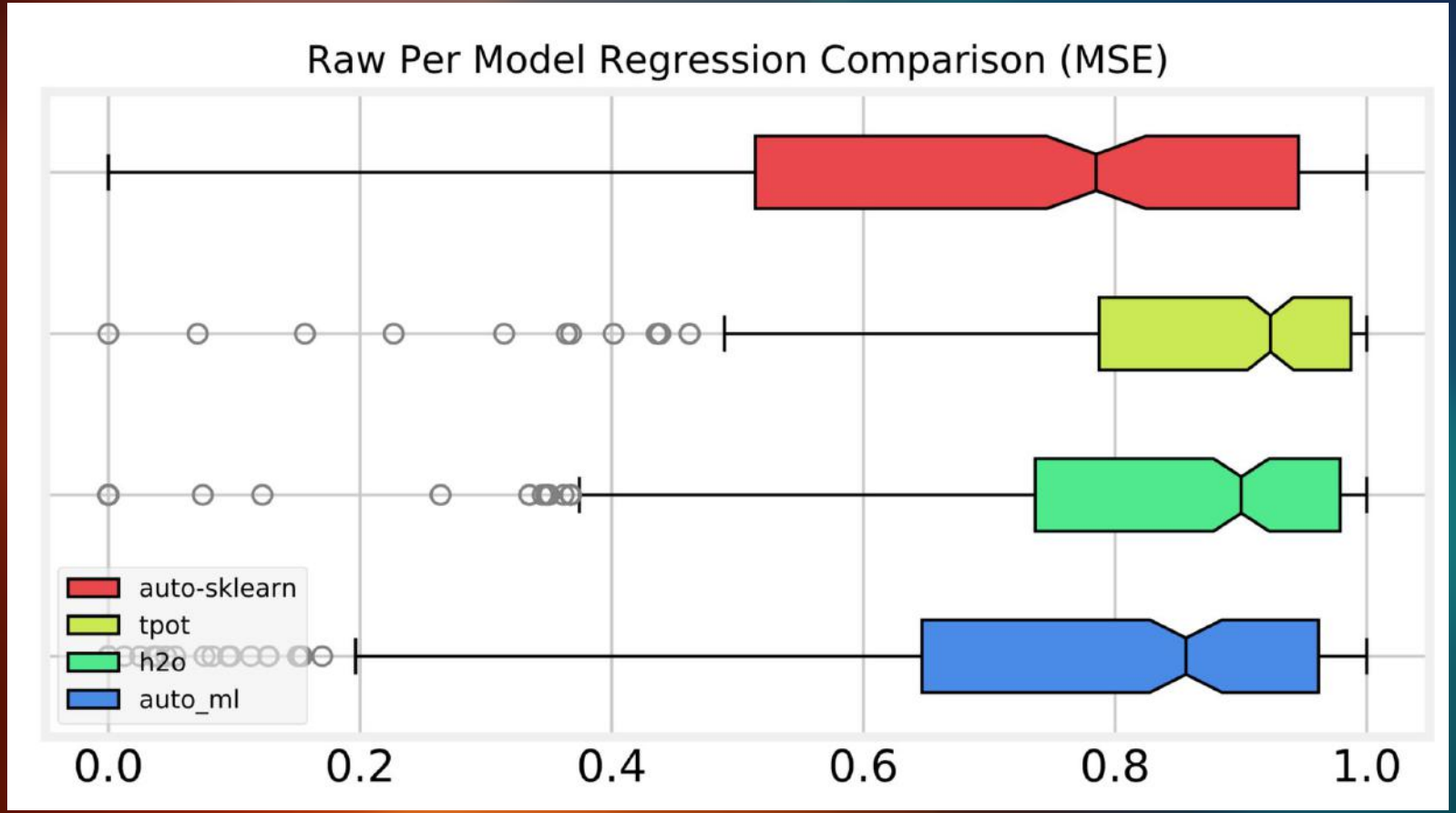
H2O automl: 51% Accuracy

Benchmarking Automatic Machine Learning Frameworks

Adithya Balaji, Alexander Allen

https://arxiv.org/abs/1808.06492


Raw Per Model Classification Comparison (F1_SCORE)
auto-sklearn
tpot
h2o
auto_ml
0.0
0.2
0.4
0.6
0.8
1.0


Raw Per Model Regression Comparison (MSE)
auto-sklearn
tpot
h2o
auto_ml
0.0
0.2
0.4
0.6
0.8
1.0

Automated Machine Learning—A Paradigm Shift That Accelerates Data Scientist Productivity @ Airbnb

https://medium.com/airbnb-engineering/automated-machine-learning-a-paradigm-shift-that-accelerates-data-scientist-productivity-airbnb-f1f8a10d61f8

Automated Machine Learning

- Exploratory analysis
- Selective discovering
- New ideas for your model
- Model optimization

Progress isn’t made by early risers. It’s made by lazy people trying to find easier ways to do something.

– Robert A. Heinlein

Thank you!

@jdiegoh

DiegoHueltes

Diego Hueltes

diego@hueltes.com

https://www.hueltes.com/automl